

LAKE COUNTY, ILLINOIS

2014 SUMMARY REPORT PETITE LAKE

PREPARED BY THE
LAKE COUNTY HEALTH DEPARTMENT
Population Health-Ecological Services



Figure 1. American Lotus colonizing Petite Lake, 2014.

Petite Lake is one of the 13 lakes sampled in the Fox Chain 'O' Lakes during 2014 by the LCHD-ES. It is a glacial lake whose maximum depth is 19 feet and surface area is 195.44 acres. The lake water elevation is influenced by the McHenry Dam which was built in 1939. From June—September water levels were measured at the gage on the north side of the Spring Lake bridge in order to track changes in water levels during the season, the lake experienced a decrease in water level during the monitoring season of 4.8 inches. However, the greatest fluctuation occurred between May and June at 1.2 feet. Petite Lake is hydrologically connected to the northern lakes via Spring Lake and Bluff Lake. Historically, Petite Lake was not connected to the northern lakes until channelization formed Spring Lake in the early 1900's. Using data supplied by Southeastern Wisconsin Regional Planning Commission and Lake County Mapping Services, the watershed of Petite Lake was estimated at 25,757.51 acres and encompasses the sub-watersheds of both Trevor Creek (WI) and Sequoit Creek (IL). The dominant land uses found in the watershed were agriculture, single family and water and wetlands. The greatest percent runoff was estimated to come from single family and transportation.

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SUMMARY (CONTINUED)

Lake Facts:

Major Watershed: Fox River

Sub-Watershed: Trevor and Sequoit Creek

Location: T43N, R9E, Section 11

Surface Area: 195.44 acres

Shoreline Length: 6.36 miles

Maximum Depth: 19.00 ft.

Average Depth: 5.15 ft.

Lake Volume: 1251.58 acre-ft

Watershed Area: 25,757.51 acres (WI and IL)

Lake Type: Glacial

Management Entity:

Fox Waterway Agency

State of Illinois

Homeowners Associations (various)

Current Uses: swimming, boating, aesthetics

Access: Jo Als and Cypress Resort, private launches and additional public launches on other lakes of Fox Chain 'O' Lakes.

Petite Lake is used for recreational boating and aesthetics and is well known for its sandbar that is heavily used as a social meeting place. There are two privately owned public launches on Petite Lake; they are at Jo Als and Cypress Resort. Additionally, Chain 'O' Lakes and Oak Point state parks also offer public boat launching at their facilities. Additionally, private launches are offered to members of Highwood and Beachwood Subdivisions. Fishing by shoreline on Petite Lake is limited as nearly its entire shoreline is under private ownership, therefore, fishermen usually access the lake from public launches on the Fox Chain 'O' Lakes.

In 2014, the LCHD-ES sampled the lakes for the water quality parameters discussed in this report. Once a month water chemistry samples were collected at the deep hole of the lake at 3 feet from the surface (epilimnion) and lake bottom (hypolimnion) by use of a Van Dorn sampler. A multi-parameter sonde was used to collect depth profile data. Additionally, a Secchi disc was lowered into the water column to measure the water clarity of the lake. Other environmental data was recorded including air temperature, water elevation and notes of wildlife in the area.

The overall water quality of the Petite Lake is poor. The average water clarity was 2.0 feet in 2014, this is below the county median Secchi depth of 2.95 ft. Petite Lake ranked 116th out of the 158 lakes whose average Secchi depths have been recorded since 2000.

Like many of the lakes in our county, Petite Lake is impaired for phosphorus based upon the Illinois Environmental Protection Agency's (IEPA) phosphorus standard for general use of ≥ 0.05 mg/L TP for lakes with surface area greater than 20 acres. It only takes one exceedance of the standard per season to be considered impaired. The average TP concentration in the epilimnion was 0.102 mg/L. This is below the median TP concentration of 0.126 mg/L found in the Fox Chain 'O' Lakes in 2014 and is significantly above the county median TP concentration of 0.068 mg/L. Petite Lake ranked 114 out of 173 lakes in the county sampled for TP since 2000.

A vegetation survey was conducted utilizing a randomized grid generated by ARCGIS 10.2 to determine points to sample within the lake footprint. The point intercept method was employed to estimate the cover of vegetation on the lake bottom. The vegetation was estimated by scoring the amount of vegetation collected by a rake tossed at each grid point sampled. An analysis of vegetation data was conducted using a modified Braun-Blanquet scale to estimate species cover, frequency and relative importance. Relative importance is determined by summing the relative cover and relative frequency. Plants were found at 29.8% of the 190 points sampled in Petite Lake. The total average cover at those points was estimated to be 6.59%. This well below the 2014 average cover of 27.3% estimated for the entire Fox Chain 'O' Lakes. Dominant species were determined by ranking the relative importance of the species, with the top 50% of the considered dominant. In 2014, there were three co-dominant species in Petite Lake; they were Eurasian Watermilfoil, and White Water Lily and Coontail. Maps estimating the cover of vegetation in the lake as well as of EWM were created. These maps are designed to assist in aquatic plant management planning.

SUMMARY (CONTINUED)

American Lotus populations were mapped out for the entire Fox Chain 'O' Lakes. The LCHD-ES has been monitoring Lotus beds in the Fox Chain 'O' Lakes since 2000. American Lotus was first discovered on Petite Lake in 2012 and have been expanding with new populations being documented in 2014, it was even detected at one of the sample points during the 2014 survey.

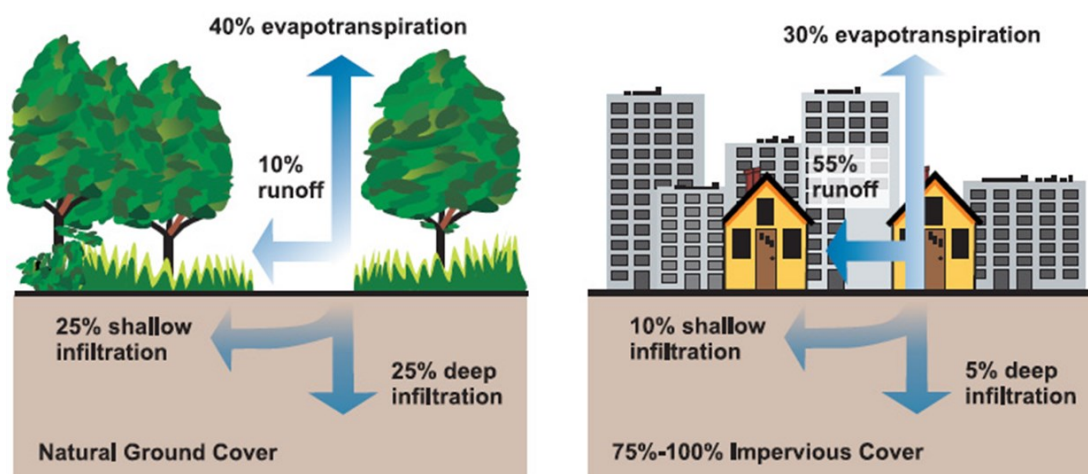
In 2014, ten species were detected in Petite Lake. A floristic quality assessment was conducted on the aquatic plant species, resulting in a FQI score of 18.7. Floristic quality assessments are usually conducted on terrestrial systems, however they are useful for determining natural areas, site comparisons, and long term monitoring of natural areas and restoration projects. Petite Lake ranked in the top 55 of 170 lakes in the county scored for FQI and was above the median score of 15.2.

WATERSHED

A general definition of a watershed is an area of land defined by two or more high ridges. Watersheds however are usually much more complex than that due to the engineering of drainage areas designed to remove stormwater more efficiently from the landscape. This can make boundaries hard to decipher at times. As watersheds develop the amount of impervious surface increases resulting in a greater influx of runoff entering our waters due to reduced infiltration of rainwater into the ground.

Petite Lake has an expansive watershed encompassing Trevor Creek and Sequoit Creek sub-watersheds which total approximately 25,757.51 acres (SEWRPC and Lake County Mapping Division). According to land use data, the watershed is dominated by Agriculture (24.7%), Water (14.1%) and Wetlands (11.7%). However, it is estimated that greatest percent of total runoff comes from Single Family and Transportation at representing 35.7% and 22.0% respectively (Appendix A, Table 1).

The LCHD_ES recommends that agencies and homeowners associations within the entire watershed work together to educate homeowners and municipalities of the important role that they play in the health of Petite Lake. They should promote management practices in the watershed that reduce nutrients both within residential and agricultural communities. They should also encourage winter road maintenance providers to follow recommended salting rates and proper use of deicing materials. Many of the residents in the Petite Lake watershed are on septic. It is important that they maintain their septic systems and repair any failing septic. Antioch Wastewater Treatment Plant is a significant source of phosphorus in the Sequoit Creek watershed as it is permitted to discharge the equivalent of 12.5 pounds of phosphorus into Sequoit Creek daily, just one pound of phosphorus can generate between 300—500 pounds of algae.



WATER CLARITY

Water clarity is important as it allows light to penetrate into the water column. This light is used by the primary producers (plants and phytoplankton) for their growth. Water clarity is measured by lowering a Secchi disk into the water until it can no longer be seen by the naked eye. The resulting depth is recorded.

In 2014, Secchi depth measurements ranged from 1.0 feet in May to 3.5 feet in June, resulting in an average Secchi depth of 2.0 feet. This is well below the county median of 2.95 feet for lakes measured between 2000 and 2014 for water clarity (Appendix A, Table 2). The average water clarity in Petite Lake decreased 23.66% since 2002 when the average Secchi depth was 2.62 feet. Like Petite Lake, most of the lakes in the Fox Chain 'O' Lakes experienced decreased water clarity, however, none suffered as much as that of Channel and Catherine Lakes (Figure 2).

Weather patterns, aquatic vegetation algal blooms, boat propellers, dredging, and invasive species can all impact water clarity.

Stormwaters carry nutrients, sediments and other pollutants that can impair water clarity. According to the Long Lake rain gauge (Lake County Stormwater Commission), May precipitation measurements accumulated to a total of 3.77 inches of rainfall, which is comparable to the 12 year average May precipitation measurement of 3.21 inches. June rainfall totals were well above the 12 year average of 4.64 in., with a total of 6.93 in. recorded at the Long Lake gaging station. However, two weeks prior to our June 2014 sampling event cumulatively only 1.01 inches of rain that fell in the region. The amount of rain therefore falling

Figure 1. Comparison of Secchi depth measurements in Petite Lake, 2002 and 2014

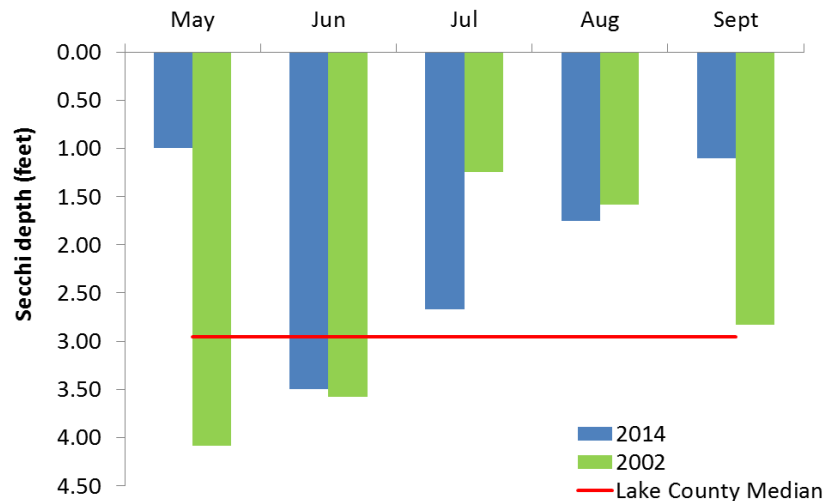


Figure 2. Secchi Depths from 2002 and 2014 for the Fox Chain'O'Lakes

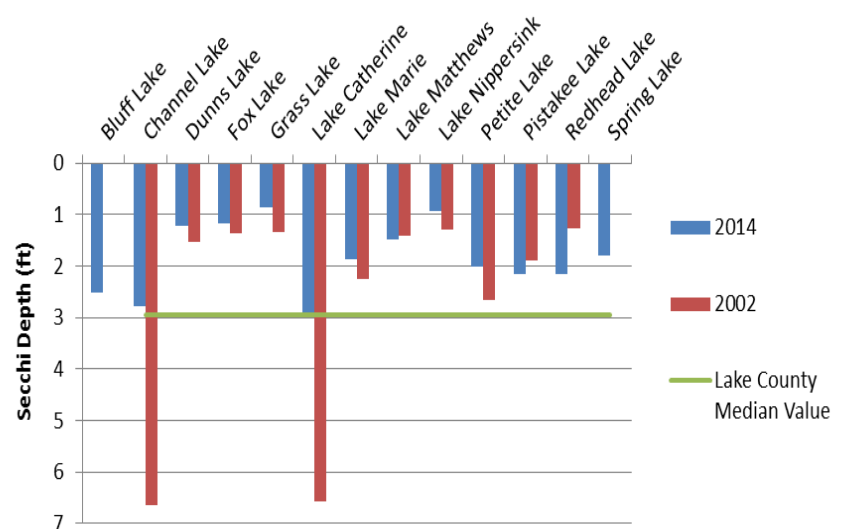


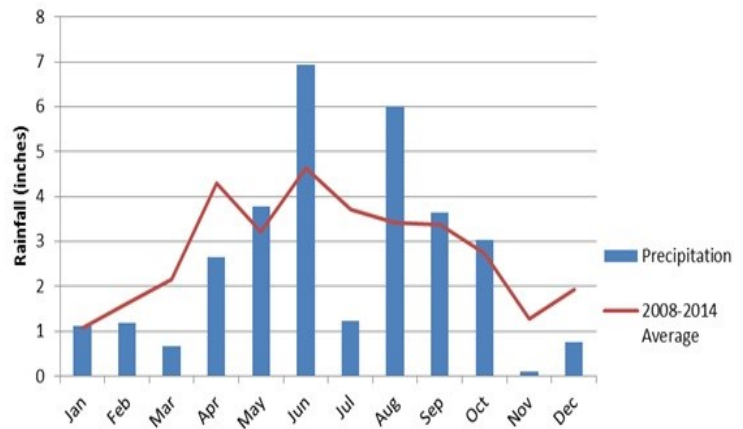
Figure 2. Secchi depths from 2002 and 2014 for all lakes' on the Fox Chain. Note the significant decreases in water clarity for Channel and Catherine lakes.

WATER CLARITY (CONTINUED)

between sampling events in June and July could explain the increase in Secchi depth in June (3.50 ft.) followed by a decrease in July (2.67 ft.).

Aquatic plants can help to improve water clarity as they compete with algae for resources such as phosphorus, nitrogen and light, and trap sediments. Water clarity suffers in lakes with little or no vegetation. Planktonic algal blooms were noted throughout the entire monitoring season in Petite Lake and likely contributed to the poor water clarity measured in 2014. Petite Lake ranked #116 out of 158 lakes in terms of water clarity based upon Secchi depth measurements taken in the county since 2000 (Appendix A, Table 4).

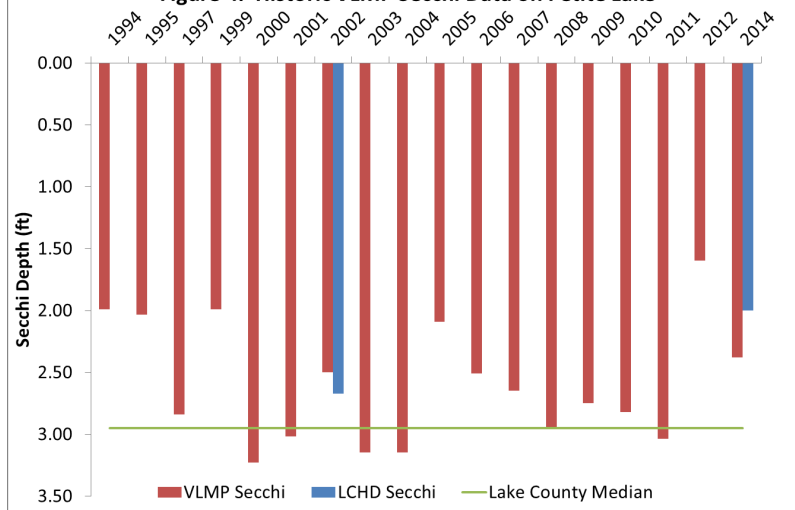
Figure 3. Monthly precipitation totals at Long Lake rain gauge, 2014



VOLUNTEER LAKE MONITORING PROGRAM



Figure 4. Historic VLMP Secchi Data on Petite Lake



The Volunteer Lake Monitoring Program was established in 1981 to assist in gathering water quality information on Illinois lakes and to provide an educational program for citizens interested in lake water quality. The primary measurement taken by all volunteers in the program is Secchi disk (water clarity). Other observations such as algal blooms, vegetation, water color, and wildlife, plus any observations that the VLMP feels noteworthy are recorded. The sampling season is May through October, two visits per month are required under the program.

VOLUNTEER LAKE MONITORING PROGRAM (CONTINUED)

Historical VLMP data for Petite Lake is presented in Figure 4, the water clarity has fluctuated over the years with depths averaged across all sites on the lake ranging from 1.60 feet to 3.23 feet in 2012 and 2002, respectively. Something happened between 2011 and 2012 that accounted for a 46.37% decrease in water clarity, this pattern was observed in other northern lakes during the same period. The VLMP data presented in Figure 4 is just one example of the importance of VLMP data. It can assist in identifying impacts when they occur as well as to provide a continuous set of data during times when the lake is not being actively monitored by agencies. Due to the increased number of samples and frequency of sampling that occurs under the VLMP program, it is expected that there will be slightly different results from data collected by agencies as exhibited in the 2014 VLMP and LCHD-ES data.

TOTAL SUSPENDED SOLIDS

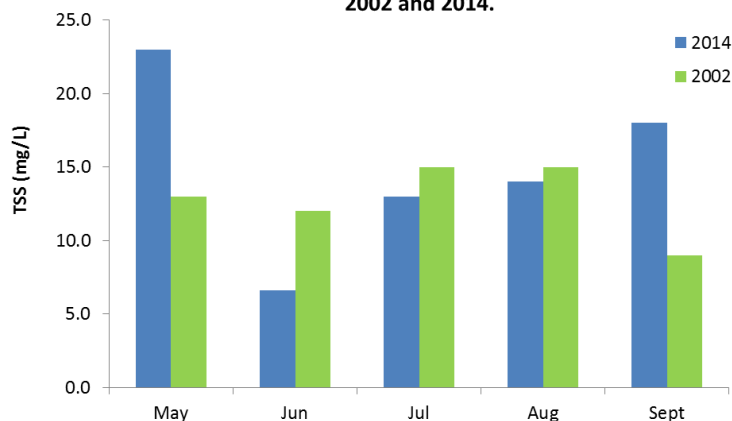
Total suspended solids (TSS) are comprised of volatile (organic) materials and nonvolatile (inorganic) materials within the water column. Total suspended solids reduce water clarity and can impact both flora and fauna when prevalent. Examples of volatile solids are plankton and plant material as well as small macroinvertebrates. Non-volatile solids are sediments. TSS concentrations are inversely correlated to water clarity, hence when TSS concentrations are elevated, water clarity is diminished.

In 2014, TSS concentrations in Petite Lake ranged from 6.6 mg/L in June to 23.0 mg/L in May (Figure 5; Appendix A, Table 3). The 2014 average TSS concentration of 14.9 mg/L was greater than median TSS concentration of 8.2 mg/L for lakes in the county measured for TSS since 2000. The 2014 average TSS increased slightly since 2002 when the average TSS concentration was 14.0 mg/L.

In 2014, total volatile solids (TVS) ranged from 117 mg/L in September to 164 mg/L in August. The 2014 average TVS concentration measured in the epilimnion in 2014 was 138 mg/L; this is greater than the county median concentration of 121 mg/L for county lakes measured for TVS since 2000. There were large differences between TVS concentrations between 2014 and 2002 due to analytical differences between different laboratories used and therefore are not comparable.

Chlorophyll A (ChlA) samples were collected in July—September from lakes monitored in 2014. ChlA concentrations increased during the sample period with concentrations ranging from 51.8 in July to 95.8 in September. All of the concentrations found in Petite

Figure 5. TSS concentrations (mg/L) in Petite Lake, 2002 and 2014.



Lake were above the average ChlA concentrations of 47.1 for lakes in the county sampled for ChlA in 2014.

In 2014, non-volatile suspended solids (NVSS) in the form of sediments ranged from 15.42 mg/L in May to 3.76 mg/L in June. This explains the 76.62% decrease in TSS concentration between May and June. Elevated non-volatile solids in May were likely due to spring rains flushing the system.

Activities in the watershed can contribute to the increases in TSS found in Petite Lake, however, internal loading by boat propellers churning up bottom sediments and nutrients can cause algal blooms. It is recommended stakeholders on best management practices that they can incorporate into their daily lives that can reduce sediments from entering into surface waters. Additionally, residents of Petite Lake should promote a long term aquatic plant management plan on the Fox Chain 'O' Lakes to allow for expansion of vegetation in sensitive areas. Aquatic vegetation can filter sediments and other pollutants out of the water column as well as provide competition to algae.

SEDIMENTS

Sedimentation naturally occurs in our environment, however, human activities can increase the amount of sediment that ends up in our surface waters. Sediments are usually fine grained sands, silts and clays that can cover up the coarser bottom sediments and the spaces between rocks and cobbles that provide habitat for aquatic life.

In the Midwest region, sediments entering into surface waters through erosion are laden with phosphorus and are major source of eutrophication to lakes and streams. Sediment particles absorb warmth from the sun resulting in increased water temperatures which can cause decreased dissolved oxygen and if low enough can stress fish.

Sediments reduce water clarity which reduces the amount of light penetrating into the water. This impacts a plants ability to photosynthesize and plant propagules (seeds) to reestablish and results in reduced fish and macro-invertebrate habitat. Additionally, sediments bury and suffocate fish eggs and gravel nests. The Fox Waterway Agency (FWA) provides the service of removing sediments deposited from the Fox River and other tributaries to the lakes within the Fox Chain 'O' Lakes. The sediment load coming from all tributaries has been calculated to be steady at approximately 100,000 yds³/year. Of that sediment, 12%, or approximately 12,000 yds³/year enter the Fox Chain 'O' Lakes through Lake Catherine from Trevor Creek. An additional 16,000 yds³/year are estimated to come from both Sequoit Creek and Squaw Creek.

According to the FWA, Grass Lake is the main recipient of the sediment load for the Fox Chain 'O' Lakes and is at or near capacity. Therefore much of the 2014 dredging efforts were focused in Grass Lake, Fox Lake and Lake Marie. The FWA is not supported through tax revenues but by annual sticker fees required by boaters using the lakes of the Fox Chain 'O' Lakes. Dredged sediments are used to construct islands that provide habitat to birds navigating and nesting in and among the Fox Chain 'O' Lakes. There are threatened and endangered bird species who utilize the islands and other areas of the Chain; however, recently we have observed increased gull activity on the islands as well. The FWA frequently tests the dredged soils and results from a 2005 study conducted by Hey and Associates shows that sediment concentrations for most parameters (total phosphorus as P, Arsenic, Cadmium, Chromium, copper, Lead, Manganese, Nickel, Zinc, and Mercury) fall within the "Low" or "Normal" classification based on the IEPA's Illinois Lake Sediment Classification. A classification system developed by Mac-



Figure 6. Location of dredging activities on the Fox Chain 'O' Lakes, 2014.



Figure 7. Fox Waterway Agency dredging a channel in Lake Marie, 2014.

SEDIMENTS (CONTINUED)

Donald et al.(2000), supports these findings as their classification system indicates that adverse effects from pollutants are either not expected or would be rarely observed in the majority of the sediment dwelling organisms.

Table 1. Most of the pollutants sampled in dredging sediments by Hey and Associates compared to IEPA and Mac-

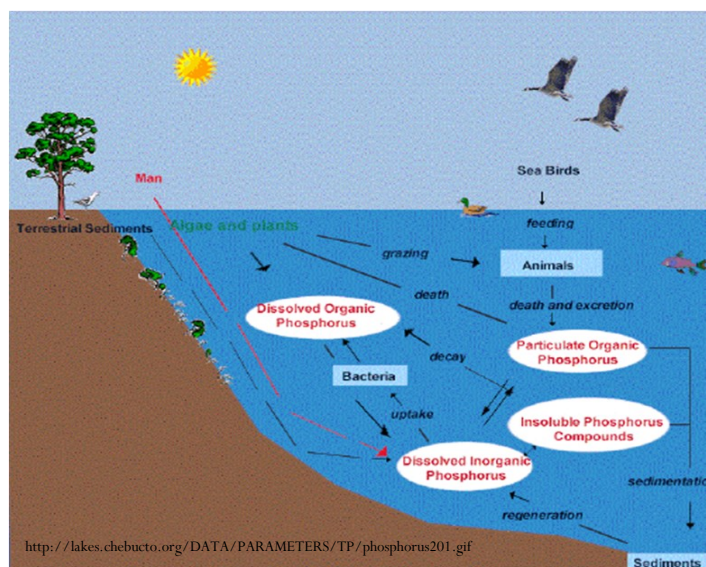
Metal	Value (Hey & Associates)	IEPA Illinois Lake Sedi- ment Classification	MacDonald et al. Sedi- ment Guidelines
Arsenic	12 mg/kg	Normal (4.1 to <14)	Below ERL
Cadmium	<0.5 mg/kg	Normal (<5)	Below LEL
Chromium	20 mg/kg	Normal (13 to <27)	Below LEL
Copper	14 mg/kg	Low (<16.7)	Below LEL
Lead	18 mg/kg	Normal (14 to <59)	Below LEL
Mercury	0.11 mg/kg	Normal (<0.15)	Below LEL
Nickel	14 mg/kg	Low (<14.3)	Below LEL
Zinc	51 mg/kg	Low (<59)	Below LEL

ERL: Effect range-low: represents the chemical concentration below which adverse effects would be rarely observed

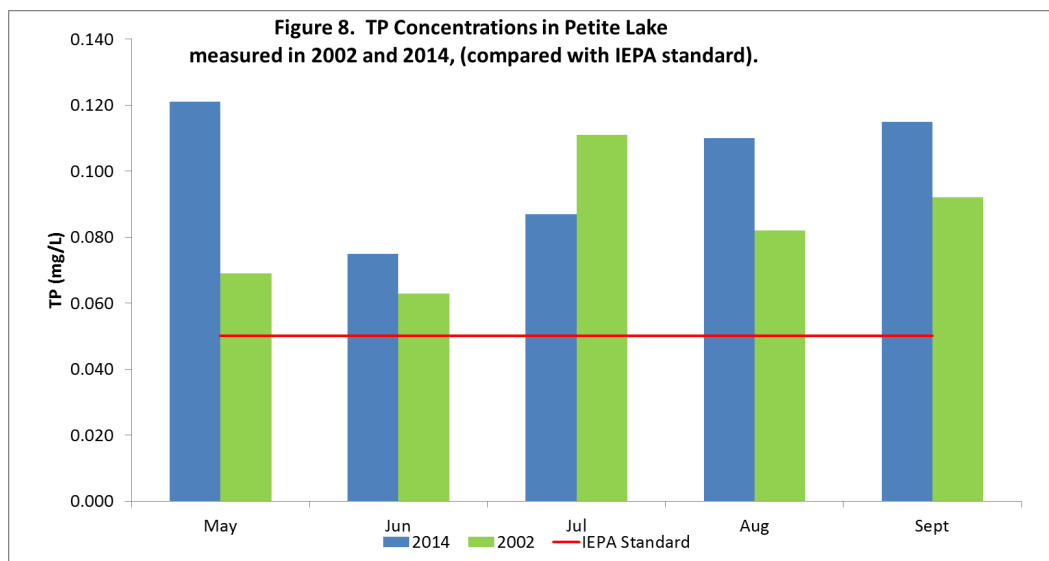
LEL: Sediments are considered to be clean to marginally polluted. No effects on the majority of sediment dwelling organisms are expected below this concentration

NUTRIENTS

Phosphorus and nitrogen are essential, naturally occurring nutrients needed for plant growth; however when in excess they can impair water quality. Phosphorus is usually the nutrient which causes water quality problems for lakes. There are internal and external sources of phosphorus, and in general it is the easiest of the limiting nutrients to manipulate due to the ability of some plants and algal species to fix nitrogen from the atmosphere as well as from the water. High phosphorus levels in lakes can lead to excessive algae and aquatic plant growth which can harm aquatic life and impair recreational use as water clarity is reduced and oxygen is depleted. External sources are those that occur in the watershed; however, internal sources can also contribute nutrients into the water column. Internal sources are boat propellers, carp, eroding shorelines, internal



NUTRIENTS



loading and release of phosphorus from dying and decaying plant material.

A 1991 article (see sidebar) looking at engine horsepower versus mixing depths supports the theory that power boating on shallow lakes such as Petite Lake can stir up the nutrient rich bottom sediments. Petite Lake is renowned for its use by recreational boaters who congregate at the Petite Sand Bar on evenings and weekends. This area is shallow allowing for the boaters to anchor and socialize. It is likely that many boats entering into the shallows of Petite Lake have boat whose horsepower exceeds a mixing depth equivalent to the bottom and therefore contribute to the poor water quality found in Petite Lake.

Horsepower	Mixing Depth
10	6
28	10
50	15
100	18

Source: Lakeline, December 1991

Herbicide treatments which are targeted to kill all plants can cause a spike in nutrient availability due to the release of nutrients previously assimilated by plants for growth upon plant die off.

The Antioch Sewage Treatment Plant discharges into Sequoit Creek. The plant has recently upgraded its facilities to help it keep in compliance under the Clean Water Act for phosphorus. Under the CWA the plant has a monthly average limit of 1.0 mg/L and a daily maximum limit of 2.0 mg/L. The maximum phosphorus load that the Plant is permitted to discharge on average to Sequoit Creek is equivalent to 12.5 pounds of phosphorus a day. It is estimated that one pound of phosphorus can produce between 300 and 500 pounds of algae.

Although Petite Lake did not thermally stratify in 2014, in July the waters near the lake sediments did become anoxic near the bottom sediments (Appendix A, Table 6). Bottom sediments become anoxic as DO concentrations near the lake bottom approach 2 mg/L and are known to cause nutrient release into the water column. Due to the rapid assimilation of available nutrients it is not possible to tell if this happened in Petite Lake in 2014. However, it is possible that in some years the lake becomes polymictic (mixing several times in a season) and could become an important source of nutrients into Petite Lake. Both phosphorus and nitrogen were plentiful during entire the monitoring season as supported by the TN:TP ratio calculated for Petite Lake; since there was very little vegetation to compete with algae, algal blooms were prolific. Excess nitrogen, especially early in the season can promote the growth of blue green algal blooms due to their ability to fix nitrogen.

Petite Lake is impaired for total phosphorus and has been dating back to at least our 2002 monitoring year. Lakes are considered impaired for total phosphorus (TP) under the Illinois Environmental Protection Agency (IEPA) standard when concentrations in the water column exceed 0.05 mg/L the lake is considered impaired. Figure 9 presents monthly TP concentrations in Petite Lake in 2002 and 2014. TP concentrations in 2014 ranged from 0.075 mg/L in June to 0.121 mg/L in May (Appendix A, Table 3). The average TP concentration in Petite Lake was 0.102 mg/L during the monitoring season (May—Sept), this is

50% higher than the median TP concentration of lakes within the county during the period of 2000—2014 of 0.068 mg/L.

A ratio between total nitrogen and total phosphorus (TN:TP) is a tool used to determine which nutrient is limiting plant or algal growth in a lake. Ratios of less than 10:1 indicate a system limited by nitrogen, while lakes with ratios greater than 20:1 are limited by phosphorus. The average TN:TP ratio calculated for Petite Lake in 2014 was 20, therefore neither nutrient was limiting the growth of plants or algae, the monthly TN:TP ratio supports this in all months except for June, the TN:TP ratio of 24 indicated that in June plant and algal growth was limited by phosphorus.

TROPHIC STATE INDEXES



OLIGOTROPHIC:

Lakes are generally clear, deep and free of weeds or large algae blooms. Though beautiful, they are low in nutrients and do not support large fish populations.



MESOTROPHIC:

Lakes lie between the oligotrophic and eutrophic stages. Devoid of oxygen in late summer, their hypolimnions limit cold water fish and cause phosphorus cycling from sediments.

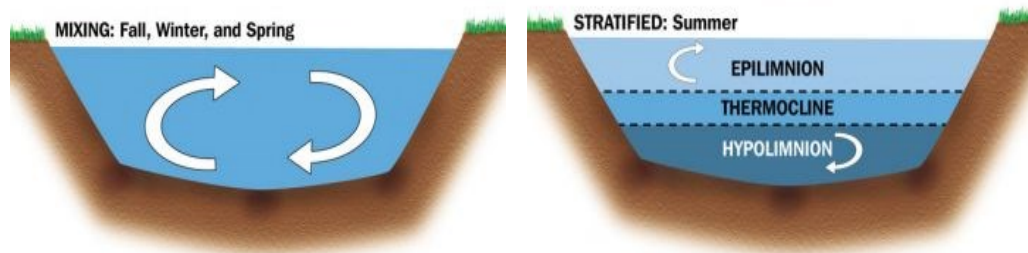


EUTROPHIC:

Lakes are high in nutrients, they are usually either weedy or subject to frequent algae blooms, or both. Eutrophic lakes often support large fish populations, but are also susceptible to oxygen depletion.

A Trophic State Index (TSI) based on phosphorus (TSIp) is commonly used to classify and compare lake productivity levels (trophic state). Excessive phosphorus entering a lake can accelerate the rate of eutrophication. Eutrophication is a natural process of a lake aging; where a lake begins with clear water and few aquatic plants and over time become more enriched with nutrients and vegetation, until it becomes a wetland. This process normally takes thousands of years, however, human activities that supply lakes with additional phosphorus significantly speed up the eutrophication process. The TSIp index classifies the lake into one of four categories: oligotrophic (nutrient-poor, biologically unproductive) mesotrophic (intermediate nutrient availability and biological productivity), eutrophic (nutrient-rich, highly productive), or hypereutrophic (extremely nutrient-rich, productive). In 2014 Petite Lake was considered hypereutrophic with a TSIp score of 70.84. The TP phosphorus concentrations measured in Petite Lake caused it to be ranked 114 of 173 lakes in the county whose TP concentrations have been ranked since 2000 (Appendix A, Table 5).

STRATIFICATION



Thermal stratification occurs when lakes separate into an upper layer (epilimnion) and a lower layer (hypolimnion) due to a drop in temperature making conditions such that the wind and water currents are not strong enough to continually mix warmer waters of the epilimnion with the cooler bottom waters and waters of the hypolimnion. Dissolved oxygen (DO) and temperature profiles are normally a good visual of stratification taking place in a lake. Figure 10 presents the DO and Temperature profile for Petite Lake in 2014 and indicates that it did not thermally stratify. In general, a temperature change of $>1^{\circ}\text{C}$ per meter is generally accepted as enough to cause a change in density to begin thermal stratification. The change in DO during July is likely due to respiring algae rather than the inability to warm waters not being able to retain oxygen.

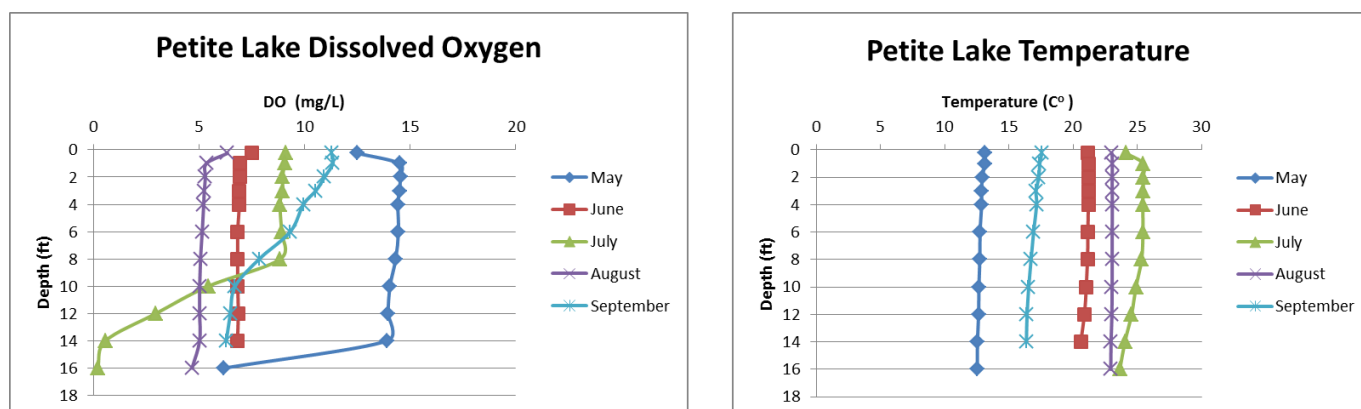


Figure 10. Dissolved oxygen and temperature profiles of Petite Lake in 2014.

DISSOLVED OXYGEN

Dissolved Oxygen (DO) is essential for the survival of fish and invertebrates in a lake and influences many different biological and chemical processes in lakes (Indiana Department of Environmental Management, 2011). Dissolved oxygen is affected by changes in temperature and temperature changes can effect the density of the water resulting in thermal stratification. As lakes stratify, normally waters in the epilimnion warm while those of the hypolimnion are cooler and get trapped beneath the thermocline. The DO is then used up in the hypolimnion as the cooler, better oxygenated waters of the epilimnion are no longer able to mix with those of the bottom and the water can become anoxic (<1.0 mg/L DO). These conditions can cause some dramatic changes to some water quality parameters.

DISSOLVED OXYGEN (CONTINUED)

Anoxic conditions did occur in Petite Lake below the depth of 14 feet during July. This is normal for lakes in the middle of summer. Waters of the bottom sediments become anoxic as waters near the bottom become low. Waters with up to 2 mg/L DO near the bottom are enough to cause anoxic conditions in the bottom sediments. This can cause the release of phosphorus into the water, which can add phosphorus into an already phosphorus rich system, causing excessive plant growth or more usually algal blooms especially when they occur in late summer. This can be caught in thermally stratified lakes, but for lakes such as Petite, the additional phosphorus can be immediately taken up by aquatic organisms for their growth.

Fish can become stressed when DO concentrations are at or below 5 mg/L. In August, the DO concentration at one foot of the surface was 5.35 mg/L, which is near the limit for considering a lake impaired for DO. However, DO concentrations in Petite Lake did not fall below the 5 mg/L threshold until after 14 feet of the surface and therefore was not a concern in 2014. However, there are other years when this can become a problem, especially in nutrient rich shallow lakes such as Petite Lake as it can lead to anoxic conditions and fish kills. The fisheries biologist from the IDNR suggests that as long as anoxic conditions do not expand above 14' depths, there will be a sufficient volume of oxygenated water for fish to utilize. Calculating volumes is usually done by use of a morphometric table constructed from bathymetric map data. This information can assist in many lake management decisions or plans. Petite Lake does not have an updated bathymetric map on file at this time.

Concerns arise when %DO concentrations becomes supersaturated (DO >100%) due to plants or algae producing oxygen more rapidly than it can escape into the atmosphere. Although rare, excess DO can cause "gas bubble disease", this is where oxygen bubbles or emboli block the flow of blood in the blood vessels of fish. %DO concentrations exceeded 100% throughout the entire water column of Petite Lake in May, through 10' below the surface in July and to 6' below the surface in September. DO saturation in June and August returned to concentrations at or below 100%, likely due to the stormwater inundating the system.

DO concentrations could be improved in the presence of aquatic vegetation. Petite Lake should investigate sensitive areas appropriate for keeping boat traffic away from and allow for expansion of vegetation into those areas. Alum treatments and aeration systems have been tried in Lake Catherine, but ultimately have not produced long term solutions due to the volume

ALGAE

Algal blooms have historically occurred on Petite Lake and blooms were again observed in 2014. Algae, like plants utilize dissolved phosphorus and nitrogen for their growth. Like plants, they can have balanced populations or they can become imbalanced resulting in a bloom. This is usually due to an excess of nutrients. Increased phosphorus concentrations have been demonstrated to cause algal blooms and nitrogen especially if it is elevated in late Spring (May), can cause summer algal blooms. HABs can gain the competitive advantage over other algal species due to their ability to fix nitrogen from the atmosphere in addition to assimilating it from the water

Recently, increased awareness in Harmful Algal Blooms (HABs) has initiated an effort to track such blooms in lakes within Lake County as well as statewide. HABs are associated with blue green algae. HABs appear as either a pea green color throughout the water column, or can appear as a blue-green slime on the surface of the water. In 2013, the LCHD-ES chose a subset of licensed beaches that would routinely be sampled for HABs., Highwood Subdivision Beach was selected to be part of that program. Biweekly a sample was taken during sampling for e-coli as part of our beach program. The sample was processed and sent to an independent laboratory for enzyme linked immunosorbant assay (ELISA) for the toxin microcystin. The 2014 sample results were below detection limits. In 2013, the limits were well below the standard for no contact defined by the World Health Organization of ≥ 20 ug/L. The LCHD-ES does encourage shoreline owners and associations that have unlicensed beaches to license their beach to protect themselves from any consequences that might occur due to either a HAB or e-coli contamination of recreational users at their beach areas. Regardless of whether or not there is a beach present, if it suspected that a HAB is present in Petite Lake, it should be reported. A water sample will be collected and an Abraxis test per-

formed to determine if toxins are present. If the results of Abraxis indicate that toxin is present at >10ppb, the contact person will be advised and it will be recommended that people and their pets remain out of the water until the bloom subsides. The sample will also be sent to an independent laboratory to have ELISA performed. The results will be reported back to the LCHD-ES.

CHLORIDES/CONDUCTIVITY

Conductivity measures the amount of ions in water, the more ions or salts in the water the higher its conductivity. It can be used to estimate both total dissolved solids ($R^2 = 0.96$) and chloride concentrations due to a strong correlation ($R^2 = 0.94$) between these parameters. Sources of chlorides are road salts (40% chloride) which are used in winter deicing programs by both public and private maintenance crews and water softener systems. The USEPA has determined that 230 mg/L of chloride is the critical concentration in which adverse impacts to aquatic ecosystems are possible if the critical concentration is maintained for prolonged periods. Although certain species can be impacted at much lower concentrations. It only takes 1 teaspoon of salt (chloride) to pollute 5 gallons of water (230 mg/L).

Recent trends show increasing chloride concentrations in surface and ground waters in the County. The chloride ion does not bind to soils or sediments so once in the water they remain there indefinitely, unless the water is diluted or treated by a reverse osmosis system, which is a very costly and not very practical for most surface water applications.

In 2014, the average chloride concentration in Lake Catherine was 91 mg/L with concentrations ranging from 87.0 mg/L to 94.0 mg/L. Chloride was not a parameter tested for in 2002. Conductivity which was measured in 2002 was used to estimate chloride concentrations in the epilimnion in 2002 it is estimated that chloride concentrations in water of the epilimnion exhibited a slight increase of 4.5% occurred between 2002 and 2014.

Although chloride concentrations were not highly elevated in 2014, single family and transportation were estimated to be the two highest contributors of total percent runoff, and therefore homeowners and those winter road maintenance crews should minimize their salt usage. Many residences in the Fox Chain 'O' Lakes remain on septic. If using a water softener, there is no removal of chloride from the waste water, as it percolates through our soils and eventually into the lake. Shifts in algal populations to blue green algae have been found and many invasive species are more tolerant of high chloride levels which can cause management issues. Saltwater is more dense than freshwater and therefore can get trapped in bottom waters eventually changing the volume of water mixed in the lake which can affect the entire ecosystem in the lake.

The LCHD-ES and Lake County Stormwater Management Commission (LCSMC) have been holding annual training sessions targeting deicing maintenance personnel for both public and private entities. Since 2010 we have provided training to approximately 468 winter maintenance personnel on the recommended application rates for applying deicers while still maintaining safe passageways. Almost all deicing products contain chloride so it is important to read and follow product labels for proper application. For instance, at a pavement temperature of 30°F, rock salt will efficiently melt ice; however at 10°F it is ineffective and therefore another product would be required to melt ice. Check with your HOA to see what is required of private companies hired to deice roads in your subdivisions. Support changes in deicing policies proposed by the local township in their attempts to incorporate best management practices into their routines.

Pavement Temp. °F	One Pound of Salt (NaCl) melts	Melt Times
30	46.3 lbs of ice	5 min.
25	14.4 lbs of ice	10 min.
20	8.6 lbs of ice	20 min.
15	6.3 lbs of ice	1 hour
10	Dry salt is ineffective and will blow away before it melts anything	



AQUATIC PLANTS

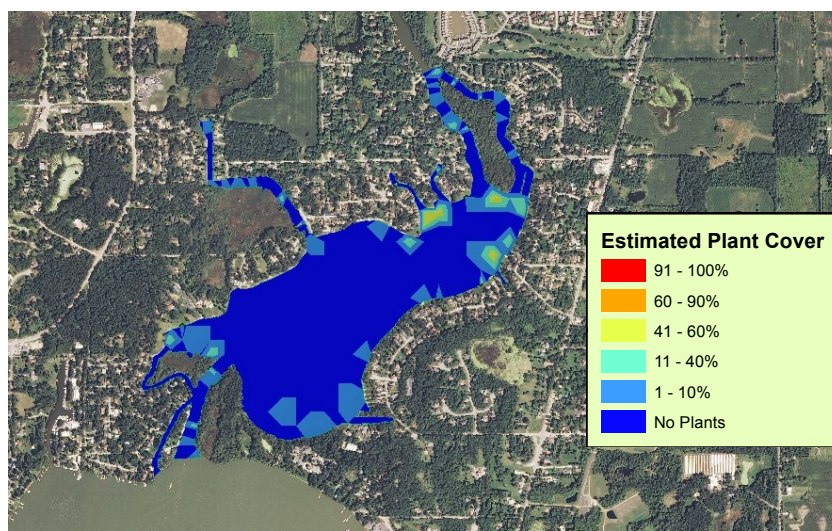


Figure 12. Status of vegetation in Petite Lake, July, 2014.

Aquatic plants are a critical component in lakes as they uptake available nutrients such as phosphorus from the water column making it unavailable for use by algae, filter sediments and other pollutants from the water, and stabilize bottom substrates. They also provide habitat for nesting and nursery for fish and other aquatic organisms. At times, nuisance growth has been encountered by due to invasive species and eutrophication. Aquatic plant management plans that include monitoring of the vegetation provide data making it easier to make the best decisions toward aquatic plant management.

In July 2014, an point intercept survey was conducted on the aquatic vegetation in Petite Lake. In order to accomplish this a randomized 60-meter grid was overlaid on an aerial photo of Lake Catherine using ARCGIS10. A total of 230 points fell within the lake footprint. Of those points 190 were sampled as they fell within depths above 12 ft., this is the average depth that plants are likely to be detected given a 3—5 ft. Secchi depth. Every point was sampled in the littoral zone regardless of plant presence; points lying at depths greater than 12 ft. were not sampled.

To sample the vegetation, a rake was lowered into the water and then scored from 1—5 (Appendix A, Table 7). Each species was scored then scored from a modified scale. The scales were converted to a percentage value using the midpoint of a percentage range which was associated with each score. The midpoint was used to estimate species cover. A total of 193 points were sampled and species cover, relative cover, frequency, relative frequency and relative importance were quantified using a modified Braun-Blanquet scale (Mueller-Dombois, Ellenberg, 2002) Appendix A, Table 7 presents the estimated cover, frequency and relative importance for each species detected in the July, 2014 survey. A ranking of relative importance determined dominant species in the lake.

In 2014, vegetation was found at 28.9% of the 190 points in the lake with an estimated average cover of 6.59%. Ten plant species, 8 native and two non-native invasive species were detected. Three plants were co-dominant; Eurasian Watermilfoil (EWM), Coontail and White Water Lily. EWM is a non-native invasive aquatic species commonly found in lakes in the Midwest. Coontail is a native aquatic plant, and is tolerant of low light conditions. White Water Lily is a floating native plant that occurs along the shorelines of lakes, however, in proper conditions has been found to colonize the entire water surface. Areas of aquatic vegetation are presented in Figure 12.(Appendix A, Figure 6). These plants along with American Lotus are spotlighted along below.

A floristic quality assessment was performed using the aquatic plant species found in Petite Lake resulting in an FQI score of

AQUATIC PLANTS (CONTINUED)

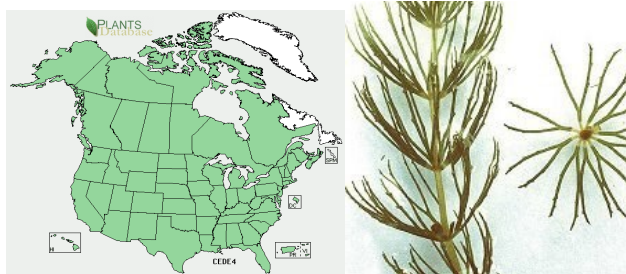
18.7. A floristic quality assessment is commonly used in four applications; identification of natural areas, comparisons among sites, long term monitoring and monitoring habitat restoration. Since pesticide treatments take place in Petite Lake FQI can be used as a tool to determine the extent if pesticides have been misused or the response of the native plant community from aquatic plant management activities. The FQI score of 18.7 was above the median value for lakes scored for FQI in the county since 2000. Petite Lake ranked 22nd out of 179 lakes in the county assessed for floristic quality (Appendix A, Table 8).

Eurasian Watermilfoil, is a non-native aquatic invasive plant species was detected at 25.25% of the points assessed. The other common invasive non-native aquatic plant found in Petite Lake was Curlyleaf Pondweed, was found at 1.05% of the points sampled with an estimated cover of 0.05%. The life history of Curlyleaf Pondweed has its growth peaking in June, and dying back by mid-July so the true abundance of this species may not have been captured.

The LCHD-ES is recommending that Petite Lake adopt a long term aquatic plant management plan that is developed by all stakeholders of the lake (lake associations, citizens, townships, park districts etc.). The plan would provide a template that describes the goals of aquatic plant management in Petite Lake and assists in determining what objectives need to be employed to attain those goals. If a plan is not developed it is recommended that areas within the lake be identified to allow for expansion of native plants. If chemical treatments are used to control invasive species, they should occur in when water temperatures are cooler as warm water temperatures can increase breakdown of some chemicals by microbes, also early treatments minimize impacts to native plant populations and do not interfere with fish spawning. Consideration should be given to what type of plants are present, aquatic plants like terrestrial plants are of two types monocots and dicots. Monocots contain all pondweeds, duckweeds, naiads, elodeas and others. Dicots include the watermilfoils, white water lily, spatterdock, Coontail, white water crowfoot and water marigold. Curlyleaf Pondweed is a monocot and Eurasian Watermilfoil is a dicot, so the strategy used to control them may differ if you are going after one versus the other or both, as chemicals can be adjusted to be

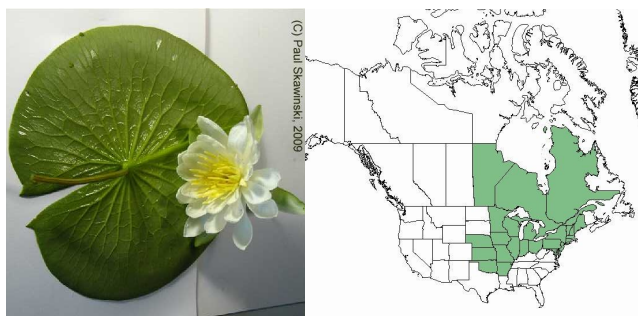
COONTAIL (DICOT)

Coontail (*Ceratophyllum demersum*) is a widespread native in and around the United States and Canada. It is identified by its forked whorl of leaves which extends the length of the stem. Early in the season, plants can be confused with Chara, a macroalgae.



WHITE WATER LILY (MONOCOT)

White Water Lily (*Nymphaeae tuberosa odorata*) is a widespread native in and around the United States and Canada. It is identified by its floating round leaf with a slit from near the center of the leaf to the leaf edge. The leaf stalk is round in cross section. It has a showy white composite flower that sits on the surface of the water. It can be confused with Spatterdock and American Lotus.



INVASIVE SPECIES—EURASIAN WATERMILFOIL

Eurasian Watermilfoil (EWM) is an invasive submerged aquatic plant that can quickly form thick mats in shallow areas of lakes and rivers in North America. These mats can interfere with swimming and entangle propellers, which hinders boating fishing, and waterfowl hunting. Matted milfoil can displace native aquatic plants, impacting fish and wildlife. Since it was discovered in North America in the 1940's (Couch & Nelson), EWM has invaded nearly every US state and at least three Canadian Provinces. Milfoil spreads when plant pieces break off and float on water currents. It can cross land to new waters by clinging to sailboats, personal watercraft, powerboats, motors, trailers, and fishing gear.

EWM was found at 12.63% of the points sampled with an average cover of 1.88%. In 2014 applications were received by the DNR for spot treatment of EWM and CLP in April and August. In 2013, an application was received for spot treatments scheduled for June.

LCHD-ES did not conduct an early season sampling in 2014, however the results of our August survey indicate that EWM remained a dominant plant in the aquatic plant community. However its average cover was quite low. Figure 11 indicates that there are a couple of areas where it's cover was capable of impeding recreational use. These areas could be targeted for eradication of EWM. Rapid growth of EWM occurs when water temperatures are at approximately 59°F. Therefore it is possible to treat populations early to prevent impacting any native plants present. However, due to the overall low abundance of aquatic vegetation, consideration might be given to keep stay away from some areas until the population creates a nuisance for boat traffic as it does provide competition to algae.

Recently a hybrid between EWM and the native Northern Watermilfoil have been encountered. The hybrid milfoil has proven to be less sensitive than either parental species to certain herbicides. Therefore, it is important to know whether the hybrid is present or to occasionally switch chemicals used to treat EWM to reduce the chance of chemical sensitivity being reduced in the future.

EURASIAN WATERMILFOIL IS THE TOP DOMINANT SPECIES IN PETITE LAKE IN 2014

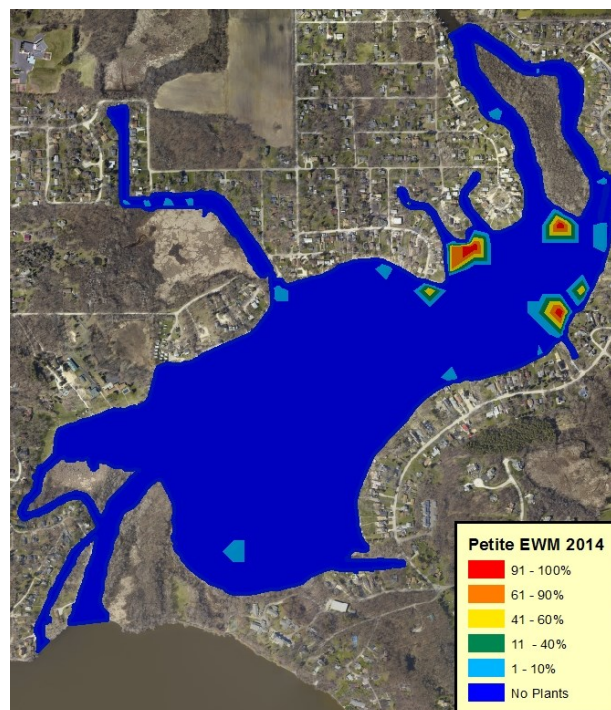


Figure 11. Status of EWM on Petite Lake, July, 2014.

MYRIOPHYLLUM SPICATUM **Exotic***

COMMON NAMES:

EURASIAN WATERMILFOIL

ORIGIN: EXOTIC

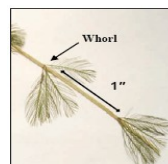
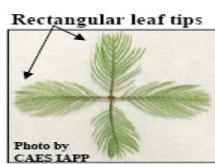
EUROPE AND ASIA. FOUND THROUGHOUT LAKE COUNTY AND ILLINOIS

IMPORTANCE:

THIS INVASIVE PLANT SPREADS RAPIDLY, CROWDING OUT NATIVE SPECIES, CLOGGING WATERWAYS, AND BLOCKING SUNLIGHT AND OXYGEN FROM UNDERLYING WATERS.

LOOK ALIKES:

NORTHERN WATERMILFOIL; HYBRID MILFOIL WHICH HAS FEWER THAN 12 LEAFLET PAIRS PER LEAF, AND GENERALLY HAS STOUTER STEMS.



KEY FEATURES:

LEAF: LEAVES ARE RECTANGULAR WITH ≥12 PAIRS OF LEAFLETS PER LEAF AND ARE DISSECTED GIVING A FEATHERY APPEARANCE, ARRANGED IN A WHORL, WHORLS ARE 1 INCH APART.

FLOWER: SMALL PINKISH MALE FLOWERS THAT OCCUR ON REDDISH SPIKES, FEMALE FLOWERS LACK PETALS AND SEPALS AND 4 LOBED PISTIL.

AMERICAN LOTUS (DICOT)

American Lotus, (*Nelumbo lutea*), is a native aquatic plant to Illinois and much of Midwest with populations found from Massachusetts to Minnesota; south to Florida and Texas; and in California. *Nelumbo* is Ceylenian for “sacred bean” and *lutea* is Latin for yellow. In Lake County the flowers of the American Lotus can be seen in Fox Lake, Grass Lake, Nippersink Lake, Petite Lake, Dunn’s Lake, Lake Matthews, Pistakee Lake, Sullivan Lake, and East Loon Lake. Back in the late 1800’s, Grass Lake was almost entirely covered with this unique plant each summer. A visit by tour boats to the American Lotus beds became popular for vacationing Chicagoans in the 1890’s. Today there are still areas of Chain O’ Lakes in which American Lotus blossoms are prevalent. In late spring the leaves, which can reach 2 feet in diameter, usually stand a foot or two above the surface of the water on thick stems. The flower buds appear in early summer and bloom in July. The showy flowers are seen rising above the tallest leaves with a bright yellow pistil (female organ) surrounded by dozens of stamens (pollen producing male organ). Flowers open in the morning and close at night for two days and then the petals begin to fall off. During this time cross-pollination occurs with the help of insects. Although the petals are gone, the center of the flower continues to grow until it is about 3 inches in diameter. The seed pod can contain up to 20 seeds. The pods are often used in dried floral arrangements. American Lotus reproduces in three ways; through its banana shaped tubers, rhizomatous growth and by germination of seed.

Aerial photography from 1939—1959 was evaluated from the Soil Conservation Service (USACOE, 1999) the results of the evaluation are presented in (Appendix A, Table 9). It was thought that the American Lotus was nearly extirpated from the Fox Chain ‘O’ Lakes. This came at a time when small motorboats were found to dominate the lakes’. Many of those interviewed in the 1996 report by the USACE about the lotus populations recalled that the state and other private interests removed aquatic vegetation in the lakes for several years from the late 50’s until the early 60’s. It was documented that there was a slight comeback of lotus in Grass Lake in the 1970’s; however it was also reported that by the late 1970’s those populations once again disappeared.

The Fox River and Chain O’ Lakes Waterway Agency established a “No-Wake Zone” of 150 feet of shorelines in 1993, it was during the period of 1992 and 1996 that lotus are documented to have reappeared in Grass Lake. The LCHD-ES has measured populations since 2000 and it is estimated that in 2014, 272 acres of lotus occupy the waters of the Fox Chain O’ Lakes; of that approximately 0.5 acres was reported from Petite Lake. Appendix A Table 9 quantifies the lotus populations in the Fox Chain O’ Lakes from 1939 to present. A map depicting the location and expanse of American Lotus on the Fox Chain ‘O’ Lakes is shown in Appendix A, Figure 6. There are some populations that do not appear on the map due to the identification of individual plants or very small populations. Matthews Lake had American Lotus detected at one of the vegetation survey sample points however it was not detected during the mapping of Lotus populations in September, 2014.



Figure 11. Status of American Lotus in Petite Lake, 2014.

AMERICAN LOTUS (*NELUMBO LUTEA*)

COMMON NAMES: AMERICAN LOTUS

IMPORTANCE:

WATERFOWL EAT SEEDS; ATTRACT MARSH BIRDS, WILDFOWL, SONGBIRDS ROOTS ARE EATEN BY BEAVER (FASSETT, 1957) FISH FOR HABITAT; PERFUME, FLORAL ARRANGEMENTS

LOOK ALIKES:

WHITE WATER LILY, SPATTER-DOCK



KEY FEATURES:

PLANT: FLOATING PERENNIAL FROM FLESHY RHIZOME;

LEAF: BLUE GREEN CIRCULAR LEAF IS ATTACHED TO PETIOLE AT CENTER OF THE BLADE. NO SLITS OR LOBES.

FLOWER: SHOWY WHITE—YELLOWISH FLOWER EXTENDS ABOVE THE WATER SURFACE FROM THE

AQUATIC PLANT MANAGEMENT

**FOR FULL DETAILS
OF PART 895 SEE:**

[HTTP://
WWW.ILGA.GOV/
COMMISSION/ICAR/
ADMINCODE/017/017
00895SECTIONS.HTML](http://www.ilga.gov/commission/icar/admincode/017/01700895sections.html)

Herbicide application is a tool utilized by home owner associations, individual residents and lake managers for the control of aquatic plants in Petite Lake. Targeted species are usually non-native invasive species; however our records indicate that there are areas treated that are additionally colonized by native species.

By Administrative Code, applying herbicides on Petite Lake or any other lake in the Fox Chain 'O' Lakes requires a permit by the Illinois Department of Natural Resources (IDNR). In order to obtain the permit an application needs to be filed with the IDNR requesting a permit for pesticide application, the application can be filled out by the applicant or their representative (which is usually the pesticide consultant). It should minimally document the location and area of treatment, species targeted, pesticide and application rate as well as an estimated time when pesticide will be applied. There is an exemption for needing the letter of permit (LOP) if you are treating an area less than 0.25 acres. However, exempt individual are responsible to abide by other applicable laws or ordinances. Any pesticide application into the Fox Chain 'O' Lakes needs to be done by an applicator licensed under the Illinois Department of Agriculture. The application can be obtained at the Fox Waterway Agency through its website at or its website (www.foxwaterway.com). The IDNR has 45 days to issue or deny the permit. The Fox Waterway agency has the right to review all applications and can recommend denial of a permit if it feels that it could cause harm to the environment. Chemicals should only be used if they are labelled and registered with the Illinois Environmental Protection Agency. More information is available at the link to Part 895 of the Administrative Code which covers management of aquatic plants on the Fox Chain 'O' Lakes.

A NPDES permit is required before applying pesticides over or near waters of the state. A notice of intent to apply pesticides needs to be filed with the state and can be found at the following website: <http://www.epa.state.il.us/water/permits/pesticide/forms/noi.pdf>. There is a 14 day public notice period and additional information may be requested so plan ahead. Either the homeowner or its representative can apply for the permit. Once issued the permit is good for 5 years. If your treatments exceed 80 acres annually additional reporting is required. Additional documentation is required in the cases where adverse affects due to a spill or overdosing occur.

The LCHD is encouraging homeowner associations and individuals and agencies to formulate a long-term Aquatic Plant Management Plan (APMP) for the Fox Chain 'O' Lakes that can be used as a template by any entity or homeowner applying pesticides into the lake. Developing the plan should consider all stakeholders that utilize the lake. The plan should describe all methods of control and select the best management tool for the lake, explain why it was chosen. The plan should consider timing of pesticide application, targeted species, and pesticide selection. Distributing information on pesticides that are approved for aquatic use should be included so that the person(s) responsible for lake management decisions are knowledgeable about the pesticides being applied to the lake and any risks associated with those chemicals. This allows them to formulate a clear concise Request for Proposal (RFP) that addresses the key considerations, sets reasonable goals and the objectives for achieving those goals. The APMP could also require monitoring of the lake vegetation to ensure that the goals are being met. This would allow for tweaking of the APMP if goals are not met. The vegetation coverage in Lake Marie was above the estimated average cover of 27.3% calculated for the Fox Chain 'O' Lakes during 2014; management decisions should consider increasing native plant populations as well as invasive species control.

BEACHES

Highwood Subdivision is the only licensed beach on Petite Lake. The beach is tested bi-weekly for E-coli contamination. Beaches are considered contaminated if the E-Coli colonies are ≥ 235 colonies/100mL. If E-coli exceeds this threshold a swim ban is issued. The LCHD-ES re-samples the beach the next business day after a ban is issued until the contamination clears. Highwood Subdivision has a history of swim bans; however, there were 16 samples that came back with E-coli concentrations coming back above 235 colonies/mL. The source of the increased number of bans is likely due to a domestic geese being kept at the property adjacent to the beach.

Since 2013, Highwood Subdivision beach is routinely sampled for HABS. A sample collected at the beach is processed and sent out to an independent laboratory for enzyme linked immunosorbant assay (ELISA). In 2014, all of the samples collected for mycrocistin were below the detection limit. In 2013, all of the samples tested for microcystin were well below the standard defined by the World Health Organization of 20 ppb.

FISH

The Illinois Department of Natural Resources continuously monitors the fish populations in the Fox Chain 'O' Lakes through biennial fish surveys. TIN, 2013, the IDNR conducted a day electroshocking survey on Petite Lake. There 2343 22 fish species detected during that survey. Bluegill and White Crappie were the most abundant fish species in the catch registering 159 and 173 individuals, respectively. However, Carp (7) and Bowfish (1), had the greatest average weight, 5.6 lbs. and 2.7 lbs., respectively.

The Fox Chain 'O' Lakes is annually stocked with 243,000 2" walleye fingerlings, 2 million walleye fry, and at least 2000 muskie fingerlings. Sixty-five thousand 4" to 6" largemouth bass fingerlings are stocked every other year. Natural reproduction maintains all other species.

FISHING REGULATIONS – Includes the Fox River from the Illinois State line to the Algonquin Dam.
Trot line fishing is permitted.

Species	Daily Creel Limit	Minimum Length Limit
Largemouth Bass and Smallmouth Bass (No more than 3 fish can be smallmouth bass, smallmouth must be released immediately between April 1 to June 15, no possession)	6	14"
Walleye	4	14" to 18" (18" to 24" protected slot limit, no possession) only 1 fish can be >24"

Muskie	1	48"
Northern Pike	3	24"

(see current Illinois Fishing Information booklet or IFISHILLINOIS website <http://www.ifishillinois.org/> for specific details).

Species	Sept, 2013
Black Crappie	1
BlueGill	159
Bowfish	1
Brook Silverside	10
Bullhead Minnow	1
Carp	7
Channel Catfish	1
Emerald Shiner	15
Freshwater Drum	42
Golden Shiner	7
Gizzard Shad	26
Largemouth Bass	21
Log Perch	2
PumpkinSeed	12
Spottail Shiner	10
Quillback	2
Walleye	48
White Bass	7
White Crappie	173
Hybrid Bluegill	99
Yellow Perch	14
Yellow Bass	5

INVASIVE SPECIES—ZEBRA MUSSELS

ZEBRA MUSSEL



ZEBRA MUSSELS WERE NOT DETECTED BY LCHD-ES IN LAKE CATHERINE DURING 2014 SURVEYS.

In the late 1990's, the presence of zebra mussels (*Dreissena polymorpha*) was confirmed in the Fox Chain O Lakes. These mussels are believed to have been spread to this country in the mid 1980's by cargo ships from Europe that discharged their ballast water into the Great Lakes. The mussels spread throughout the Great Lakes and by 1991 had made their way into the Illinois and Mississippi Rivers

Currently, 32 inland lakes in the county are known to be infested with the zebra mussel, but this number could be much higher, since the zebra mussel can go unnoticed.

The zebra mussel's reproductive cycle allows for

rapid expansion of the population. A mature female can produce up to 40,000 eggs in a cycle and up to one million in a season. They can live as long as five years and have an average life span of about 3.5 years. Adults are typically about the size of a thumbnail but can grow as large as 2 inches in diameter. Colonies can reach densities of 30,000 - 70,000 mussels per square meter. Due to their quick life cycle and explosive growth rate, zebra mussels can quickly edge out native mussel species. Negative impacts on native bivalve populations include interference with feeding, habitat, growth, movement and reproduction.

The impact that mussels have

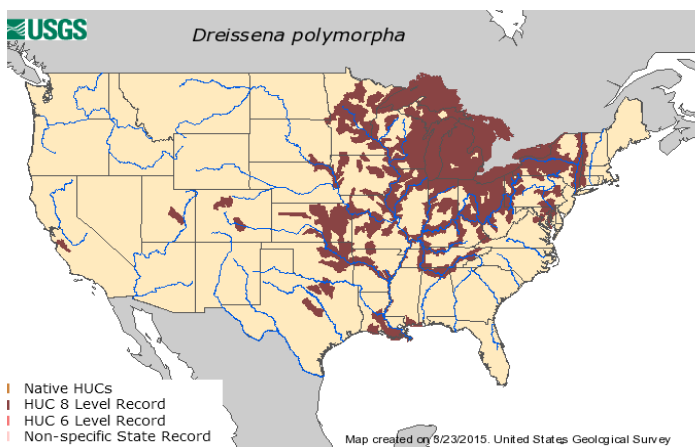
on fish populations is not fully understood. However, zebra mussels feed on phytoplankton (algae), which is also a major food source for planktivorous fish, such as minnows and shad and young of the year bluegill. These fish, in turn, are a food source for piscivorous fish (fish eating fish), such as largemouth bass and northern pike.

Zebra mussels clogging water intake pipes have caused economic hardships for power plants, public water supplies, and industrial facilities. Boats stored on the water offer suitable areas for zebra mussels to start a colony. They can eventually affect cooling and exhaust systems on boats and create



KEY FEATURES:

THE ZEBRA MUSSEL IS A SMALL SHELLFISH NAMED FOR THE STRIPED PATTERN OF ITS SHELL. COLOR PATTERNS CAN VARY TO THE POINT OF HAVING ONLY DARK OR LIGHT COLORED SHELLS AND NO STRIPES. IT IS TYPICALLY FOUND ATTACHED TO OBJECTS, SURFACES, OR OTHER MUSSELS BY THREADS EXTENDING FROM UNDERNEATH THE SHELLS. ALTHOUGH SIMILAR IN APPEARANCE TO THE QUAGGA MUSSEL (*DREISSENA BUGENSIS*), THE TWO SPECIES CAN BE EASILY DISTINGUISHED. WHEN PLACED ON A SURFACE ZEBRA MUSSELS ARE STABLE ON THEIR FLATTENED UNDERSIDE WHILE QUAGGA MUSSELS, LACKING A FLAT UNDERSIDE, WILL FALL OVER. SEE MACKIE AND CHLOSSER (1996) FOR A KEY TO ADULT DREISSENIDS



INVASIVE SPECIES—ZEBRA MUSSELS

extra drag causing lower fuel economy. Studies on the transport of the zebra mussel have shown that they can be found in any area of a boat that holds water, including the engine cooling system, bilge water, and bait buckets used in fishing. Researchers found that many of the mussel larvae were being transported via aquatic plants that were taken from one lake to another on boats and trailers. Therefore, it is important that all boats and trailers entering or leaving the Fox Chain O' Lakes are inspected for aquatic plants and all water from the bilge and motors are drained.

Recently, an experimental biocide called Zequanox has shown to be effective against zebra mussels and it is not toxic to humans, native bivalves, and fish. In-lake tests show that it reached 97.1% mortality on zebra mussels within 14 days of treatment. Zequanox is a non-chemical solution made from dead cells of a naturally occurring microbe (*Pseudomonas fluorescens*). It is highly selective to zebra and quagga mussels and has low toxicity (Marrone Bio Innovations). Currently winter drawdowns have exposed the zebra mussels along the shorelines, however prevention is the best defense against any invasive species spread. The Great Lakes Sea Grant Network provides the following tips to prevent the spread of zebra mussels:

Always inspect your boat and boat trailer carefully before transporting. Studies have shown that transport via aquatic plant fragments is one of the major contributors to the spread of zebra mussels.

Drain all bilge waters, live wells, bait buckets and engine compartments before entering another lake. Make sure water is not trapped in your trailer. Never transport water from one lake to another.

Flush clean water (tap) through the cooling system of your motor to rinse out any larvae.

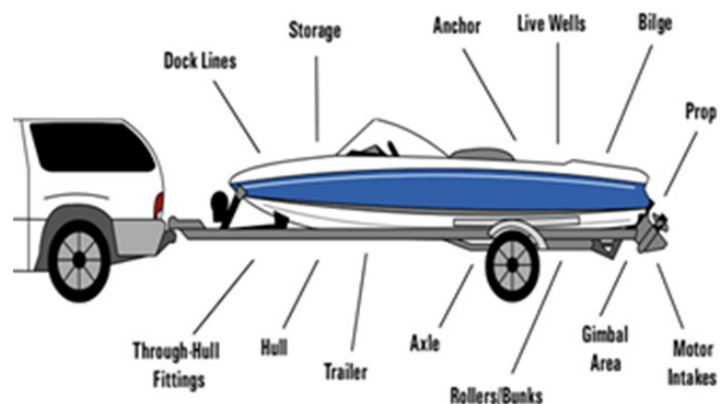
Full grown zebra mussels can be easily seen but cling stubbornly to surfaces. Boats that have been in the water for long periods of time should be carefully inspected. Carefully scrape the hull (or trailer), or use a high pressure spray (250 psi) to dislodge them. Or leave your boat out of the water for at least 5 days, preferably up to two weeks. The mussels will die and drop off.

In their earlier stages, attached zebra mussels may not be easily seen. Pass your hand across the boat's bottom - if it feels grainy, it's probably covered with mussels. Don't take a chance; clean them off by scraping or blasting.

Dispose of the mussels in a trash barrel or other garbage container. Don't leave them on the shore where they could be swept back into the lake or foul the area.



Before launching and before leaving...
Inspect everything!





ENVIRONMENTAL SERVICES

Senior Biologist: Mike Adam

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500 W. Winchester Road
Libertyville, Illinois 60048-1331

Phone: 847-377-8030

Fax: 847-984-5622

For more information visit us at:

<http://www.lakecountyiil.gov/Health/want/BeachLakeInfo.htm>

Protecting the quality of our lakes is an increasing concern of Lake County residents. Each lake is a valuable resource that must be properly managed if it is to be enjoyed by future generations. To assist with this endeavor, Population Health Environmental Services provides technical expertise essential to the management and protection of Lake County surface waters.

Environmental Service's goal is to monitor the quality of the county's surface water in order to:

- Maintain or improve water quality and alleviate nuisance conditions
- Promote healthy and safe lake conditions
- Protect and improve ecological diversity

Services provided are either of a technical or educational nature and are provided by a professional staff of scientists to government agencies (county, township and municipal), lake property owners' associations and private individuals on all bodies of water within Lake County.

RECOMMENDATIONS

LCHD-ES recommends the following actions for improving the water quality and overall health of Petite Lake:

- Develop an aquatic plant management plan for the Fox Chain 'O' Lakes that can be used as a template anyone interested in aquatic plant management on Petite Lake. The APMP should include all stakeholders of the lake, identifying any sensitive areas, or shallow areas where plants would be allowed to thrive. All methods of control should be considered during the development process and those that make sense for Petite Lake should be prioritized. The APMP can be used for obtaining quotes for pesticide application. It should include periodic monitoring to ensure that goals outlined in the APMP are being met.
- Maintain and service septic systems as leaky septic systems introduce nutrients and bacteria into Petite Lake. These can cause blue-green algal blooms (HABs) and E-coli contamination near private beaches.
- The IEPA has prioritized the funding of projects through 319 grant funds for the Fox River Watershed. Petite Lake is part of that watershed. It is recommended that a work group be formed that can identify potential projects to include in a proposal. The LCHD-ES is willing to provide guidance for producing the application proposal and implementation of any projects funded. The workgroup should include partner volunteers from the entire Fox Chain 'O' Lakes to strengthen the proposal. At least one of the partners should be an entity that has legal status to receive funds from the State of Illinois; including state and local governmental units, non-for profit organizations, citizen and environmental groups, individuals and businesses. They are funding projects identified under approved watershed plans, (Sequoit Creek). Applications are due in Springfield on August 1, 2015. Contact the LCHD at (847) 377-8030 for more information.